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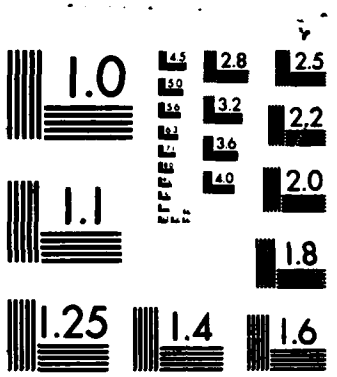

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The ~~PI's~~ studied properties (analytical, arithmetic and algorithmic) of linear ordinary differential equatious. These properties are useful for the development of efficient numerical schemes (symbolic) to produce local power series solutions, determine their radus of convergence and provide the possibility of analytic contimation of such expressions. Moreover, the flexibility to handle branch cuts (logrithmic or algebraic) must also be incorporated. The PI's produced seven papers and a monograph as well as organized an international conference "Computers and Mathematics", August 86, Stanford University during their grant support. They do exceptional work.

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Final Technical Report

Differential Equations, Related Problems of Padé Approximations and Computer Applications

by D.V. Chudnovsky and G.V. Chudnovsky

FY I

During the past year of the Grant, one of the focuses of our work was the study of analytic, arithmetic and algorithmic properties of (linear) differential equations. We continued our study of arithmetic propertis of the monodromy groups of differential equations, including development and implementation of efficient serial and parallel methods of solution of inverse and direct monodromy (Riemann) problem. Among other results we disproved the Whittacker conjecture on the explicit form of the accessory parameters in the uniformization problem for hyperelliptic curves (as a result of extensive symbolical and numerical computations). We developed and implemeted entirely new least complex algorithms for computations of solutions of (linear) differential equations with arbitrary precision [3,4], and used them in our new work on transcendence of elements of monodromy groups associated with the uniformization problem and globally nilpotent equations [1,4,8].

Our work on formal groups over Z, Z_p, and F_p in connection with computer algebra lead to new recent progress in the description of characteristic classes of Spin-manifolds and superstring models, see [5,8] for our explicit formulas for charatcteristic classes in terms of modular forms (of level 2). The work on formal groups is also connected with number theoretical algorithms (primality testing and factorization) [2].

Our more recent work on algebraic curves [6,7,8] is also closely connected with computer applications. This is our work on the least complex (lowest rank) algorithms for computation of polynomial multiplication or convolutions over Z or over finite fields F_q. We developed new interploation technique on algebraic curves, and using the theory of linear codes proved tight upper and lower bounds on the minimal number of (non-scalar) multiplications necessary to multiply two polynomials of degrees n over finite fields. This number is O(n); for details and constants see [6,7]. Our new algorithms are important in applications to fast convolution and bignum computations.

Investigators were among organizers (D.V. was a co-chairmen and G.V. was a member of the Organizing Committee) of an International Conference "Computers and Mathematics" held at Stanford University in July - August 1986.

LIST OF PUBLICATIONS OF D.V. CHUDNOVSKY AND G.V. CHUDNOVSKY FOR THE LAST YEAR SUPPORTED BY THE AIR FORCE

1. A random walk in higher arithmetic.
   Advances in Applied Mathematics, v. 7 (1986), 101-122.

2. Sequences of numbers generated by addition in formal groups and new primality and factorization tests.
   Advances in Applied Mathematics, v. 7 (1986), 187-237.

3. On expansion of algebraic functions in power and Puiseux series, Parts I and II.
   J. of Complexity v. 2 (1986), 271-294, and v. 3 (1987), 1-25.

4. Computer assisted number theory.
   I.B.M. Research Report, RC 12030, 7/23/86, 67pp. Lecture Notes in Mathematics, Springer, N.Y., v. 1240, 1987, 1-68.

5. Elliptic modular functions and elliptic genera.
   Topology, to appear.

6. Algebraic complexities and algebraic curves over finite fields.
   Proc. Natl. Acad. Sci. U.S.A., v. 84 (1987), 1739- 1743.

7. Algebraic complexities and algebraic curves over finite fields.
   I.B.M. Research Report, RC 12605, 3/24/87, 50pp.

8. Elliptic formal groups over Z and F_p in applications to number theory, computer science and topolgy.
   Lecture Notes in Mathematics, Springer, 1987 (to appear).

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